Opusc. Zool. Budapest, XVI, 1–2, 1979

On the Geographical Distribution of the Archemorus Species (Araneae, Argyopidae)

By

P. Balogh*

Abstract. Author summarizes the distribution and ethology of the known species of genus *Archemorus* (Araneae, Argyopidae). Before starting investigation only 8 species were known to belong in the genus collected in 12 localities. His material comprises 14 species collected in 230 specimens from 92 localities. On the basis of this relatively rich material the author analyses the geographical distribution of the species, their probable origin and some notes are appended to certain species concerning their hitherto unknown ethology.

While arranging the materials deriving from the collections made by the Hungarian Soil-zoological Expeditions in New Guinea and New Caledonia, and the material of the Bishop P. Bernice Museum (Honolulu) originating from the same regions it was striking to note the large number of species belonging in the genera of *Archemorus* and *Arcys*. Upon identifying the material the *Arcys* specimens proved to be three known species, while the majority of *Archemorus* are new to science. The description of the ten new species is published elsewhere (P. Balogh, 1978). The present contribution is aimed at to elucidate the geographical distribution of the species of *Archemorus*.

The spider fauna of the world, discounting the Holarctic region, is very inadequately known; this fact obviously applies to the species of *Archemorus* too. The literature brings forth a mere eight species, known from a total of 23 exemplars collected at 12 localities. They are distributed over Buru Island, New Guinea, eastern shores of Australia, Tasmania and Lord Howe Island. The material elaborated by me proves the presence of the genus in New Caledonia too. My material comprises 14 species from a total of 230 specimens collected at 92 localities. This large number of specimens and wider spectrum of distribution allow me to sketch up the range of this genus.

The comparison of literary data and my material is as follows:

* *Dr. Péter Balogh*, Természettudományi Múzeum Állattára (Zoological Department of the Hungarian Natural History Museum), 1088 Budapest VIII., Baross u. 13.

	Literature	Own material	Total
Number of species	8	14	18
Number of locality	12*	92	104*
Number of specimen	23*	230	253*

* In some cases where numerical data were not available I used a probable mean-value.

The present material, which is ten times as large as the earlier one, might suggest that on the basis of my work the distribution of the genus *Archemorus* is known. It is without doubt that in the Pacific region no other genus has such high number of data for reference. On the other hand, the examined material and the results are thought provoking.

The early materials yield 1.9 specimens per collecting locality; the average number of specimens per species is 2.9. The average specimen number per locality in my material is 2.5; the average number of specimens per species is 16.4 thus, higher values are available in both cases. On the other hand, the literary data and my material cannot be compared since there is significant difference between the two as far as distribution area is concerned. Let us see this is the following table:

	Australia		New Guinea		New Caledonia		Sunda Islands	
	lit.	own	lit.	own	lit.	own	lit.	own
Number of species	4	6	2	5	–	3	2	–
per cent	50,0	42,9	25,0	35,7	–	21,4	25,0	–
Number of collectings	8	11	2	61	–	20	2	–
per cent	66,6	11,9	16,6	65,2	–	21,6	16,6	–
Number of exemplars	16	16	2	131	–	83	5	–
per cent	69,5	6,9	8,7	56,9	–	36,0	21,7	–

The table reveals the following evidence:

1. No literary data are available from New Caledonia; on the other hand, I have no data for the Sunda Islands.

2. Among the literary data those from Australia are dominant both as far number of collectings and number of exemplars are concerned; New Guinea is falling behind; on the other hand, my data show the exact opposite of the above.

3. The species number, referring it to absolute specimen number is high in both cases (4 and 6); this means that the percentage of the species is almost the same; the percentage of specimen number is very high in the case of literature, in the case of my data very low.

Considering what has been said above, the following conclusions can be drawn. It is obvious that the majority of data from the literature derive from the last century or from early 20th century. Those collectors gathered everything at that time, they had scanty knowledge of spiders, performed their collectings simply, without using any mechanical devices. We might venture to say that

the animals were secured accidentally, consequently, in low number. In New Guinea the collectings took place but seldom. Thus, it is obvious why the majority of data originate from Australia.

On the other hand, the Hungarian Soil-zoological Expeditions comprised experts knowing spiders well; they mainly collected spiders; they applied mechanical devices (net, insect umbrella), consequently, long series of animals have been collected; furthermore, special care was invested in the canopy level, where the species of *Archemorus* are living. These collectings took place in the majority of cases in New Guinea and New Caledonia; they made collectings in Australia but here at a few localities only and for a shorter period of time.

The material belonging in the Bishop Museum was collected by full-time collectors but not by arachnologists; the collectings are evenly distributed over New Guinea, they frequently collected in New Caledonia too, while they did not send the Australian material to Budapest for elaboration. Therefore, the Australian material are scanty both in the soil-zoological collectings and in the collection of the Bishop Museum.

Attention should be drawn to the fact, that the comparatively small material deriving from Australia, 11 collectings with 16 specimens, in fact harboured 6 species of which 4 are new to science. This striking fact indicates that further species of *Archemorus* are to be expected to come forward from Australia. It might well be that the origin of the genus should be looked for in Australia.

Evaluation of the heretofore collected material

The discrepancy between literary data and my material is somewhat levelled out when we integrate the two materials and consider them as one. In the following I introduce the two as one in tabulated form.

Species	Specimen	Percentage of specimen	Number of collecting
rosdorpi CHRYSANTHUS	62	24.50	41
montanus P. BALOGH	60	23.71	4
kaszabi P. BALOGH	39	15.41	6
varians P. BALOGH	36	14.22	12
simsoni SIMON	10	3 95	6
sibil CHRYSANTHUS	8	3.16	8
alatus KEYSERLING	7	2.76	4
vicarius P. BALOGH	6	2.37	6
occidentalis REIMOSER	4	1.58	2
tuberculatus P. BALOGH	4	1.58	2
cicatrosus RAINBOW	4	1.58	1
coronatus P. BALOGH	3	1.18	3
dilatatus P. BALOGH	3	1.18	2
grandis P. BALOGH	2	0.79	2
furcatus P. BALOGH	2	0.79	2
curtulus SIMON	1	0.39	1
toxopeusi REIMOSER	1	0.39	1
transversus P. BALOGH	1	0.39	1
	253		104

The present table gives data in decreasing order much resembling those so-called "cenological" tables which are designed to illustrate the material of quantitative surveys. Interestingly enough, here too are some "dominant" species which, when compared to others, display strikingly high number of specimen, thus, when the corresponding percentage values are given they represent a significant part of the total. The first four species: *rosdorpi*, *montanus*, *kaszabi* and *varians* yield 197 specimens, i. e. 78 per cent of the whole; number of collectings 63, giving 60 per cent of the total. The rest, 56 specimens, is divided among 14 species. This obviously means that the known 18 *Archemorus* species can be divided into two major groups as far as "dominance" is concerned. The average specimen number of the first four species is 49.25, while the rest yields (of the 14 species) only 4.

In analyzing further the 4 species with high specimen number, first the *varians* should be considered. This species occurs in New Caledonia, thus, it has no direct connection with the other three species living in New Guinea. On the other hand, the other two New Caledonian species: *vicarius* and *grandis* of low specimen number are known from 6 and 2 specimens, respectively. When we compare these New Caledonian species with one another, then we find, that *varians* is "dominant" again over the other two: with 44 specimens it yields 81.8 per cent of the total number. Finally, if we compare the three "dominant" species out of the five New Guinea species, then we find that *sibil* and *coronatus* show a very low percentual value against the 93.6 per cent of the other three together. Thus, the principle of "dominance" is ever more striking when projected over a small region than over the entire Aus – tralian region. As far as New Guinea is concerned I have to say that from among the three "high dominance" species one: *rosdorpi* inhabits the montane forest zone, while the other two are found in mossy forest. Thus vertically it is separated just so as it is separated from the New Caledonian *varians* geographically.

In summarizing we may conclude that the general principle also applies within the genus of *Archemorus* as in other genera, that in one area one species is dominant while the other species are rare and collected only in small numbers. Since the ethology and ecology of *Archemorus* species are scarcely known we do not know how well the collectings illustrate the distribution and ratio of the species in nature. In the following our present knowledge is given in brief, as far as this question is concerned.

Ecology and ethology of the species

Species belonging in the group of Arcyeae, discovered first, have not been characterized ethologically. L. Koch writes in his great work on Australian spiders that the ethology of Arcyeae is wholly unknown (Koch, 1872, p. 215 – 216). The authors of the species received only dead specimens, it is most likely that Simon had the same fate, who described the genus in 1893. First it was Rainbow, an Australian arachnologist, who studied the life history of these animals. Observations referring to these species are published in Main's (1976, p. 212) book. Accordingly, the species belonging in this group spin no web at all; their preys are seized in a fashion as the crab spiders do. It is very probable that the length of the first two pairs of legs, the strong, spiny chaetotaxy are in functional relation

with this mode of prey taking. According to the observation of MASCORD (1971) the *Arcys* species hold their fore legs forward when seeking a prey, while the *Archemorus* species more or less in normal situation in lateral position.

It might be worth mentioning that the length of the 3rd and 4th pairs of legs in the *Archemorus* species scarcely differ from the first pair; and this also apllies to the newly discovered species too.

The members of the Hungarian Soil-zoological Expeditions very rarely observed the *Archemorus* species directly. They have seen most frequently *Archemorus rosdorpi* sitting on the branches of bushes and small trees. All the specimens derive from the foliage, from the canopy level through applying the so-called beating method.

All the so far known species of *Archemorus* are forest dwellers; the majority favour closed, dense and humid forests. In most cases they came forward from the mossy-forests of New Guinea at an altitude of 2800—3600 m. In this vegetation zone two species: *Archemorus kaszabi* and *A. montanus* are rather frequent. No closer biotope data are available for the two species. On the basis of collecting data however it can be stated that the 39 specimens of *kaszabi* and the 60 specimens of *montanus* do not occur in the material at the same locality at the same time.

In montane forests, further three species live in New Guinea. The most common one being *A. rosdorpi* (from 41 collectings 61 specimens) in fact yields 24.5 per cent of the total specimen number in my material. They do not occur in montane forests only but they are found also around houses, in parks, on trees, shrubs. Thus, e. g. in the park of the Wau Ecological Institute they have also been collected. Its range of altitude is also variable: it is found between 1000 and 2600 m. Another montane species is the *Archemorus coronatus*. Only three specimens are known from between 1200 and 2700 m. We have no data concerning its ethology and ecology. The dame distirbution is noted for the species of *A. sibil* collected between 800 and 2500; each time only a single specimen was collected.

The three New Caledonian *Archemorus* species: *grandis*, *varians* and *vicarius* deserve special attention. The mountains in New Caledonia are no higher than 1700 m. The elaborated material derives from much lower altitudes: below 1000 m, but it is characteristic for the ecology of three species living here that they have been collected on the very same day on an area smaller than one hectare in a small forest on Ile des Pins. Altitude below 100 m, though a systematically close relative of *varians* is *montanus* living in the mossy-forests of New Guinea between 2200 and 3600 m. The species though morphologically quite similar ecologically and as far as altitude is concerned sharply differ from each other. Apparently *Archemorus varians* is the vicariant species of the New Guinean *montanus* having adapted itself to lower altitudes in New Caledonia. We might suppose that their common ancenstor is till living or lived in Australia, where we might place the origin of the genus *Archemorus*. This is also proved by the case of *A. vicarius*. This species is an ally of *A. dilatatus* inhabiting the subtropical rain-forests of Queensland. The distribution of the two species are more similar than that of the previous two species which have diverged ecologically and also in altitude. The ecology of *A. grandis* is unknown. The only specimen collected in the canopy level of dense, tropical karst forest settled on coral limestone rock-bed.

The *Archemorus* species may be encountered from Tasmania upwards to the tropical *Eucalyptus* forests of Queensland without interruption. Ecologically, all species adhere to dense, undisturbed, humid forests. They are found both in the *Notofagus*-zone and in various temperate fern-forests, along Australia's eastern, rainy sea-shore forest belt. Of the six collected species four were new to science. A total of 16 specimens were secured, unfortunately, nothing can be said about their ecology.

Distribution of the species

The fauna of Australia and neighbouring lands developed since the Eocene until the present day. According to MACKERRAS (1973) the Auastralian fauna comprises five principal faunal elements.

1. Ancient elements: such primitive forms which survived since the Palaeozoic or Early Mesozoic, and as relics scarcely changed at all. Among the the vertebrates we find the lungfishes (Dipnoi), among the invertebrates the Onychophora.

2. Southern elements (Antarctic, South-Gondwana elements): they are characterized by two points; *a)* they represent an early stage of evolution of most orders, thus, e. g. almost all primitive sections of families in Nematocera (Diptera), and scarcely any from among the higher Diptera (Cyclorapha – Schizophora]. *b)* Their distribution area are Australia – South America, rarely Australia – South Africa – New Zealand.

3. Old northern elements (pantropic, Lemurian elements): the evolutionary centres of these are in Africa and Madagascar, whence they spread over the Indian Ocean to New Guinea and Australia, as well as into the Pacific islands.

4. Young northern elements (Oriental, Indo-malayan, partly Papuan elements): these may be considered to be such elements of Oriental origin which arrived to the region through New Guinea and Indonesia. To this group belong such highly developed forms, at the acme which represent almost all living orders in the region.

5. Recent elements; they may be *a)* air-borne planktonic elements of tiny size, *b)* actively migrating, well flying elements, or *c)* introduced by the activity of man.

The majority and the most characteristic elements of the Australian aunaf derive from points 2 and 4, i. e. from the Antarctic and Oriental – Indo-malayan elements.

BARBARA MAIN (7) attempted in her recently published book to evaluate the Australian spider fauna from this aspect. Her conclusions are quite acceptable, especially in considering the family of Argyopidae as a "modern" group of spiders, i. e. they are in the prime of their evolution. If we start off from this inevitable fact then we should suppose that the Arcyeae group belongs in the Oriental – Indo-malayan elements.

To which faunal element this group belongs cannot be as yet decided, since *1.* It is a fact that all the species of the genus *Archemorus* live east to the Weber-line, i. e. inhabit Australia, New Guinea and some neighbouring islands. But this fact still does not allow me to conclude for certain that they originate

from there. We should accept MACKERRAS when he drew attention to the difference existing between "autochton" and "endemic" species (MACKERRAS, 1973, p. 191–192).

2. It is a fact that all species of *Archemorus* live in rain-forest, or in humid forest. The rain-forest conserves ancient forms. Ecosystems well corresponding to rain-forests have beem in existance since the Carbon: thus we can say with certainty that these ecosystems sustained forms from the Carbon to our present days.

3. It is a fact that the species of the genus *Archemorus* secondarily have lost their ability to spin a web, characteristic for the subfamily Argyopinae; it is a fact that they are at their acme, and are specialized forms, but these do not exclude the possibility that they developed since the Carbon continuously, thus at one time they originated from an ancient group. The tropical rain forests, existing since the Carbon, gave a well balanced ecosystem rending it habitable either for ancient or modern forms.

Weighing up what has been said above I have to conclude that neither the origin nor their belonging to a faunal element is certain. It is probable that after elaborating the spider fauna of Australia, and more especially those of New Guinea and New Caledonia we obtain a better picture of the problem and might be able to give better answers. Materials deriving from these regions are under investigation and shall be elaborated soon. These materials contain numerous specimens from the lower tropical rain forests, montane forests and mostly from the mossy-forests (canopy level) collected by special methods. They are in close connection with moss and the epiphyton vegetation, thus they may serve in supporting some biogeographical and evolutionary conclusions far better than a genus with a small number of species only.

Distribution of Archemorus species

In sketching up the distribution of the species and to interpret this picture I fell back upon the following facts:

1. Facts concerning the ethology of the species: though as far as relation is concerned they belong in subfamily Argyopinae, they have lost their ability to spin a web; and secondarily they adopted a prey-taking method characteristic for the crab spiders. Thus, they seize settling insects rather than flying ones. To this mode of prey-taking their fore pair of legs is modified for capturing animals.

2. Facts concerning the ecology of the species: living on leaf surfaces closely attaches the animals to the canopy level, or in other words to the forest. An environment rich in food, climatically hardly changing, almost like a "glass-house" together with the above mentioed mode of activity made them extremely sedentary in nature.

3. Facts concerning the distribution of the species: the area of the species is small in general (compared to the other spiders!); they are inclined to be vicariant both geographically and ecologically, i. e. vegetation level. Their distribution much resembles those of some terricolous, apterous insects.

Starting from these facts the so far known species of *Archemorus* may be ranged in the following distribution types:

A) In Australia:

1. Species in the Bass province:

Archemorus simsoni SIMON, 1893
Archemorus alatus (KEYSERLING, 1890)
Archemorus transversus P. BALOGH, 1978

2. Species in the Torres province:

Archemorus tuberculatus P. BALOGH, 1978
Archemorus furcatus P. BALOGH, 1978
Archemorus dilatatus P. BALOGH, 1978

B) In New Guinea:

3. Montane forest species:

Archemorus sibil CHRYSANTUS, 1971
Archemorus rosdorpi CHRYSANTHUS, 1971
Archemorus coronatus P. BALOGH, 1978

4. Mossy-forest species:

Archemorus montanus P. BALOGH, 1978
Archemorus kaszabi P. BALOGH, 1978

C) In New Caledonia:

Archemorus vicarius P. BALOGH, 1978
Archemorus grandis P. BALOGH, 1978
Archemorus varians P. BALOGH, 1978

1. The species living in the Bass province

The Bass province as it is well known, more or less coincides with the temperate forest zone; to this region belong the forests of West Australia, Tasmania, Victoria and New South Wales. It is noteworthy that this region corresponds to the *Notofagus*-belt: the beech-forests of the Northern Hemisphere are substituted in the south by extensive *Notofagus*-forests. It may be supposed that the ancient, antartic faunal elements, especially the forest dwelling forms found shelter in this region. Unfortunately, the spider fauna of this region is well-night unknown, excepting perhaps that of New Zealand. It would not be surprising to encounter several new species in this region. The species known from the literature as *Archemorus curtulus* may also belong here.

2. The species living in the Torres province

The Torres province comprises the subtropical and tropical forests of Australia. The three new species which I described from this region represent three different trends of development; the possibility is not excluded that they are in fact members of different species-groups or perhaps represent new subgenera. The species *tuberculatus* is related to *sibil* from New Guinea, the *dilatatus* with *vicarius* from New Caledonia, while the *furcatus* with its peculiarly situated eyes,

development of thorax and fore tibia does in fact differ from all other congeners almost on generic level. The great variability of forms, the large number of new species suggests that the centre of the genus is at this region.

3. The species living in the montane forests of New Guinea

All three species are of large body size, from among them *rosdorpi* is the commonest form of the genus. It is in close relation with *occidentalis* inhabiting the Buru Island; the latter is the westernmost representative of the genus. On the other hand, *Archemorus sibil* points towards the Torres province, while *coronatus* is a very oddly developed species. Its close ally is so far unknown.

4. The species living in the mossy-forests of New Guinea

A total of 99 specimens, i. e. 40 per cent of all the collected specimens, belong into two species. The large series of collectings suggests that this region is the best collected one of all. *Archemorus kaszabi* is the most specialized, very small species. As far as we know at present it is without a relative.

5. The species living in New Caledonia

The *Archemorus* species zoogeographically are extremely interesting. All three species are new to science: the occurrence of the genus in New Caledonia is shown for the first time. The species *vicarius* is in close alliance with *dilatatus* living in Queensland; the species *varians* with *montanus* inhabiting the moss-forests of New Guinea, while the species of *grandis*, the largest species of the genus, shows no relation either in Australia or in New Guinea. The two previous species morphologically are related, nevertheless they are well separable from their allies. Further two *Archemorus* species may be expected from New Caledonia: one resembling *sibil—tuberculatus*, perphaps a tiny species (only juvenile forms have been secured); the other related to *simsoni* (again only juvenile forms have been collected). It is a striking fact, that the spider fauna generally poorly represented in New Caledonia provides good grounds for the genus *Archemorus* (five species): the same number as in New Guinea, and scarcely smaller than in Australia.

Final conclusions

The species pairs in close alliance allow me to draw possible conclusions as to the sequence of populating the examined area. As a starting pair, let us consider *sibil—tuberculatus*, whose younger representatives are also found in New Caledonia. It is quite probable that we are in fact dealing here with three closely related species, of which sibil is the most ancient of form. This form gave rise to *tuberculatus* in the continent of Australia, while in New Caledonia a yet undescribed species is present represented by the juvenile form. If we accept this hypot-

hesis then we must consider the *sibil* species-group as an oriental-indomalayan element which arrived in the Australien region through New Guinea.

There is another hypothesis: let us suppose that the *Archemorus* group derives from a primitive ancestry, and as a southern, antarctic element migrated northwards. In this hypothesis the evolutionary series is *tuberculatus – sibil* and the New Caledonian species; the migration route also follows this course.

All other inferences display this dual possibility. Only one populating trends can be accepted as fairly probable: New Caledonia received its species from west and not vice versa. Species pairs representing the evolutionary trend is *simsoni* – New Caledonian juveniles – *simsoni: dilatatus – vicarius: montanus – varians* unequivocally prove that New Caledonia received faunal elements from the Bass province, from the Torres province, from the montane forests of New Guinea and also from the mossy-forests of New Guinea. As to how the population took place and in which period we have no information. Nor do we know much about the mode of distribution, how the ethology, biology and other features of the *Archemorus* species influenced dispersal.

The surprising fact that New Caledonia yielded three known species, and another two yet undescribed species (juvenile forms only) of the genus *Archemorus* may perhaps be explained by the extremely low number of Thomisid species persning a mode of living resembling that of a crab spider. Accordingly, this mode of prey-taking was taken over by the species of the genera *Archemorus* and *Arcys.*

The above discussed problems are quite interesting but final answers may only be given after the elaboration of the spider material covering the entire of New Caledonia, New Guinea and Australia.

REFERENCES

1. Balogh, P. (1978): *New Archemorus species (Araneae, Argyopidae).* – Acta. Zool. Hung., 24: – Acta. Zool. Hung., 24: 00 – 00.
2. Bonnet, P. (1945): *Bibliographia Araneorum. Tom. I.* – Toulouse, 1 – 832 pp.
3. Chrysanthus, O. F. M. (1971): *Further notes on the spiders of New Guinea. I. Argyopidae.* – Zool. Verh., 113: 1 – 52.
4. Keyserling, E. (1884 – 1890): *Die Arachniden Australiens.* – Nürnberg, 274 pp.
5. Koch, L. & Keyserling, E. (1871 – 1883): *Die Arachniden Australiens.* – Nürnberg, 1489 pp.
6. Mackerras, I. M. (1973): *Composition and distribution of the fauna.* – In: The insects of Australia. Melbourne: 187 – 202.
7. Main, B. Y. (1976): *Spiders.* – Sydney, 296 pp.
8. Mascord, R. (1971): *Australian spiders in colour.* – Sydney, 200 pp.
9. Rainbow, W. J. (1920): *Arachnida from Lord Howe and Norfolk Islands.* – Rec. S. Austral. Mus., 1: 229 – 272.
10. Reimoser, E. (1936): *Fauna Buruana. Arachnoidea.* – Treubia, 7, Suppl.: 405 – 413.